



Integrating Vision Therapy with Primitive Reflex Integration: Enhancing Visual Processing in a Child with Autism Spectrum Disorder and Phenylketonuria – A Case Report

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Introduction

Autism Spectrum disorder is a neurodevelopmental disorder affecting more than 0.6% worldwide (95% confidence interval: 0.4–1%) and 0.4% (95% CI: 0.1–1) in Asia. (1) The cause of ASD can vary from genetic, and environmental factors to molecular and biological deficits. (1)

Phenylketonuria (PKU) is a rare autosomal recessive metabolic disorder caused by a deficiency in phenylalanine hydroxylase, an enzyme responsible for metabolizing phenylalanine. This condition results in the accumulation of phenylalanine in the brain, leading to neurodevelopmental challenges, including intellectual disability and cognitive deficits if untreated (2). In rare cases, PKU may co-occur with ASD, further complicating the clinical presentation and requiring a comprehensive therapeutic strategy.

Visual impairments in ASD, including deficits in visual efficiency, attention, and motor coordination, are common but often overlooked (3). Retained primitive reflexes are usually associated with poor eye-motor control, inability to demonstrate appropriate body movement (contralateral/ipsilateral), poor postural control, visual skill deficits, visual motor deficits, and visual perception. (4,5)

Infant primitive reflexes transition into the postural reflexes which in turn helps in developing visual skills. The underdeveloped postural reflex impedes eye movement development such as fixation, convergence, and tracking, overall affecting the reading and writing skills (6). Reduced saccadic eye movement parameters (saccadic accuracy, saccadic gain) and impaired reading abilities are noted with Asymmetrical Tonic Neck Reflex (ATNR), and Symmetrical Neck Tonic Reflex (STNR), especially in Moro Reflex (MR) and Tonic Labyrinthine Reflex (TLR) (7). The integration of reflexes is critical for optimal visual functioning and overall motor control (8).

This case details the assessment and treatment of a 16-year-old male with PKU and ASD, focusing on vision therapy and reflex integration techniques to improve visual efficiency skills and visual information processing.

Case summary & Methodology

Chief Complaint:

A 16-year-old male with a known history of PKU and ASD visited our center in Chennai with his parents, presenting with asthenopic symptoms, impaired focus, and confusion with right-left, avoiding eye contact, compensatory head movements, excessive body movements (body rocking), and anxiety.

Visual symptoms:

Avoids reading, confuses or reverses letter and numbers, dislikes and avoids near tasks, uses his finger as a marker, vocalizes when reading silently and has poor reading comprehension.

Birth History and Developmental History:

The parents give a history of full-term c-section delivery without any notable health problems during the term of pregnancy.

The patient was diagnosed with PKU at 1.5 years of age and began on a phenylalanine-restricted diet there by ensuring good phenylalanine blood levels. There were several developmental delays, such as late speech and delayed motor milestones, noted by the parents. The patient also exhibited poor eye contact, limited social interaction, and excessive body rocking. He faced persistent challenges with reading and attention.

Ocular History:

No prior ocular surgeries or refractive errors were reported.

General Health:

He was taking Phenylalanine-free protein, which was imported from USA, he is 16 years old now and still continuing the diet. He is also taking additional calcium and vitamins.

Initial Examination

The initial developmental evaluation revealed significant visual efficiency deficits such as poor fixation, poor saccades, and pursuits noted with excessive head and body movements and reduced convergence measured qualitatively.

Primitive reflex testing revealed severe retention of the Moro reflex, Tonic Labyrinthine reflexes (TLR), Asymmetrical Tonic Neck reflex (ATNR), Symmetrical Tonic Neck reflex (STNR), Palmar and Babinski reflex graded at level 4. These reflexes typically integrate within the first year of life but were still retained.

The patient was unable to attempt the TVPS-R (Test for visual perception-revised to assess the visual perceptual skills), Beery VMI test (to assess the visual motor integration), and reading skills due to poor focus and excessive body rocking.

Phase 1 of the treatment:

A personalized vision therapy program was initiated; the treatment included in-office therapy sessions and home training for:

- Vision Therapy: To improve eye movement control and fixation span
- Reflex Integration Therapy: To address and integrate retained primitive reflexes with vision. Moro reflex integration was started along with visual targets.

Phase 2 of the treatment:

Post 6 months of VT rehabilitation, the patient's

- Saccades and pursuits improved to a greater extent, but mild head and body movement persisted.
- Moro reflex was integrated, so the patient was trained on TLR.
- The patient was further loaded with gross motor starting along with 10 prisms BU yoke prism and prescribed with 3 prisms BU as prescription glasses for home training.
- Therapies for Visual Information Processing Skills: To enhance visual perception and processing abilities

SACCADES	
SVI-SACCADES MODULE AND EYE HAND MODULE	Which helps in enhancing saccadic accuracy, sustained visual span and attention, peripheral awareness, eye-hand coordination, visual reaction time, bilateral integration
HART CHART	Hart chart with numbers, letters and shapes
SACCADIC FIXATOR	This entails a wall-mounted square board with a starburst design that are lighted buttons. As the buttons light up, the patient works quickly to see how many of these lit buttons they can push before they go out. The key is to keep the head still. Improved accuracy and control of saccadic eye movements.
4-SACCADIC CHART	The objectives of the chart for saccadic therapy are to increase the speed and accuracy of saccadic fixation saccadic tracking
PURSUITS	
SVI ROTATOR MODULE AND TRACKING MODULE	Rotator module integrates hand speed and pursuits and sequencing of numbers or alphabets in clockwise and anticlockwise direction. Tracking of numbers letter and pictures
PEGBOARD ROTATOR	Following of small hole for one full rotation and putting the pegs with gradually increasing the speed
MARSDEN BALL	Marsden ball has numbers or letters printed over its surface. It helps hand-eye coordination and tracking exercises and also improve peripheral vision.
PERCEPTUAL TRACKING THERAPY	The perceptual visual tracking program (PVT) is designed to address specific tracking deficits. PVT contains a variety of visual tracking procedures. Perceptual visual tracking skills are basic to all aspects of reading and other academic areas.
VERGENCE	
VTS 4	The VTS4 computer orthoptics system offers various automatic eye exercises. The patient was tried with smooth vergence protocol which are devoid of monocular cues and can be seen only during binocular vision, thus helping maximizing patient compliance.
EYE PORT BY BERNELL	Eyepor® was the first FDA cleared medical device intended to improve performances related to vision. Eyes' focusing muscles flex and relax when they follow the eyepor® programmed series of alternating red and blue lights. Because the lights turn on in different directions, patterns and speeds, your eyes exercise through their full range of motion-horizontally, vertically, diagonally, near, and far.
ACCOMMODATION	
LOOSE LENS ROCK (PLUS) FLIPPERS +/- 2.00 DS	Helps to restore normal monocular accommodative amplitude. Flipper help to train our eye to change focus from near to far distance and vice versa and improve accommodative facility
VISUAL PERCEPTUAL TRAINING	
VISUAL CLOSURE	Training was done using HTS's CPT programs and worksheets.
VISUAL MEMORY AND SEQUENTIAL MEMORY	Training was done using CPT programs, SVI tachistoscope module
VISUAL SPATIAL RELATIONSHIP	Training was done using Kirschner's arrows, slap tap, PT directionality program, and worksheet parquetry blocks
VISUAL FORM CONSTANCY	Training given with worksheets parquetry blocks
VISUAL FIGURE GROUND	Ability to locate something specific in background.
REFLEX INTEGRATION AND GROSS MOTOR ACTIVITIES	
VESTIBULAR AND AUDITORY INTEGRATION	Saccadic charts and hart chart with balance board to improve balance and spatial awareness.
REFLEX INTEGRATION EXERCISES	Targeted integration of Moro and TLR to reduce their impact on motor and visual functioning.
GROSS MOTOR ACTIVITIES	Tape walking with yoke prisms; Walking beam activities with yoke prisms; Trampoline activities with charts

TABLE 2: METHODOLOGY

Phase 3 of the treatment:

At present, the patient is

- On continued treatment for further improvement of his visual efficiency and visual perceptual skills.
- The patient's TLR is in grade 1, for which the patient is undergoing integration with visual targets

Results

A follow-up assessment at 12 months revealed continued progress. Visual efficiency had further improved (fig. 1-4), the TVPS-R, the reading skill (fig. 5), and Beery VMI (fig. 6), which initially were unrecordable, were all measured. The reading speed was measured to be 36 words/minute. Whereas fig.7 shows improved visual fixation span while reading which demonstrates enhanced focus execute. The NSBVA assessment was recordable shown in table 3.

	PRE VISION THERAPY		POST VISION THERAPY	
	RAW SCORE	PERCEPTUAL AGE	RAW SCORE	PERCEPTUAL AGE
TVPS-R 1ST VISIT				
STEREOPOSIOS				
WORTH FOUR DOT TEST				
COVER TEST				
NEAR POINT OF CONVERGENCE				
AC/A				
AMPLITUDE OF ACCOMMODATION				
ACCOMMODATIVE FACILITY				
NRA				
PRA				
MEM				

TABLE 2. TVPS RESULT PRE AND POST VT

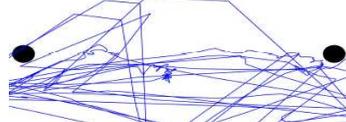


FIG. 1 PRE VT PURSUITS

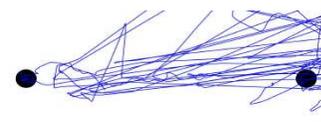


FIG.3 POST VT PURSUITS

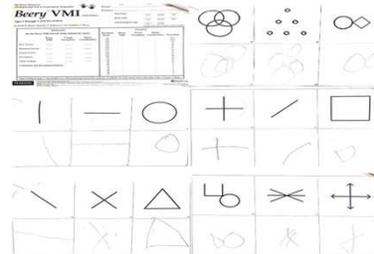


FIG 5. POST VT BEERY VMI

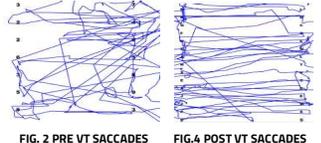


FIG. 2 PRE VT SACCADES



FIG.4 POST VT SACCADES



FIG.6 POST VT READING DATA

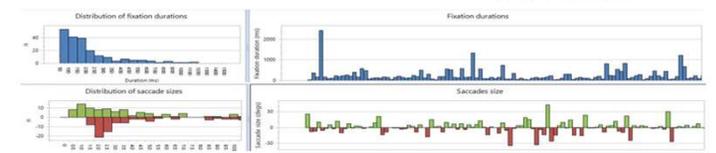


FIG.7 IMPROVED VISUAL FIXATION SPAN WHILE READING (POST-VT)

Discussion

This case demonstrates the efficacy of combining vision therapy and reflex integration techniques to address visual and developmental challenges in children with dual diagnoses of PKU and ASD. Persistent primitive reflexes have been shown to interfere with motor coordination and visual efficiency (9). The integration of these reflexes through targeted therapy contributed to improvements in both visual processing and motor control in this patient.

The relationship between visual efficiency deficits and neurodevelopmental disorders is well-documented. Deficits in saccadic eye movements, convergence, and visual-motor coordination are common in children with ASD (10). Vision therapy has proven effective in addressing these issues, improving focus, attention, and academic performance (11). Moreover, research indicates that visual-motor integration skills significantly impact academic performance, particularly in tasks requiring reading and writing (12).

Retained primitive reflexes, such as the Moro and TLR, are particularly challenging in children with ASD and PKU (13). Reflex integration exercises helped integrate these reflexes, promoting better postural control and reducing anxiety during visual tasks (14). A study done by Patti Anderich (6) emphasizes how an Optometrist who gains knowledge of the role and the effect the primitive reflexes have on visual development can use reflex movement patterns as the catalyst to improving vision skills. The significant improvement in visual processing may be attributed to the successful integration of these reflexes and the enhanced visual efficiency gained through therapy.

Conclusion

This case highlights the importance of a multidisciplinary approach in managing children with complex neurodevelopmental conditions like PKU and ASD. Vision therapy, when combined with reflex inhibition techniques, can yield significant improvements in visual efficiency, motor coordination, and academic performance. The successful integration of primitive reflexes further supports the role of vision therapy in treating visual and developmental challenges.

Further research into the long-term benefits of vision therapy and reflex integration in larger populations is warranted to validate these findings and optimize treatment protocols for children with ASD and related neurodevelopmental disorders.

References

https://docs.google.com/document/d/1qrE07pLAISV/Rh93HKCOMidkWEACX1m7sXmHGBGk/edit?usp=sharing

